

WHAT IS CLAIMED IS:

1. A negative resist composition to be irradiated with one of an electron beam and X ray comprising:

(A) an alkali-soluble resin;

(B) a compound capable of generating an acid upon irradiation with a radiation;

(C) a crosslinking agent capable of crosslinking by the action of an acid; and

(D) one of solvent mixtures (DI) and (DII):

(DI) a solvent mixture containing at least one solvent selected from the group A below and at least one solvent selected from the group B below; and

(DII) a solvent mixture containing at least one solvent selected from the group A below and at least one solvent selected from the group C below:

group A: a propylene glycol monoalkyl ether carboxylate;

group B: a propylene glycol monoalkyl ether, an alkyl lactate, an acetic ester, a chain ketone and an alkyl alkoxypropionate;

group C: a γ -butyrolactone, an ethylene carbonate and a propylene carbonate.

2. A negative resist composition to be irradiated with one of an electron beam and X ray comprising:

(A) an alkali-soluble resin;

(B) a compound generating an acid upon irradiation with a radiation;

(C) a crosslinking agent capable of crosslinking by the action of an acid; and

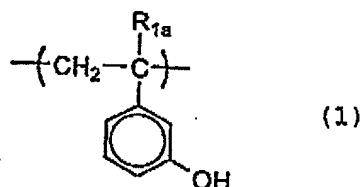
(D) a solvent mixture containing: at least one solvent selected from the group A below; at least one solvent selected from the group B below; and at least one solvent selected from the group C below:

group A: a propylene glycol monoalkyl ether carboxylate;

group B: a propylene glycol monoalkyl ether, an alkyl lactate, an acetic ester, a chain ketone and an alkyl alkoxypropionate;

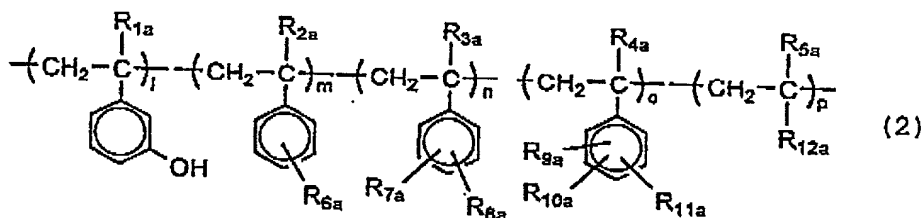
group C: a γ -butyrolactone, an ethylene carbonate and a propylene carbonate.

3. The negative resist composition as claimed in claim 1, wherein the resin (A) contains a structural unit represented by formula (1):



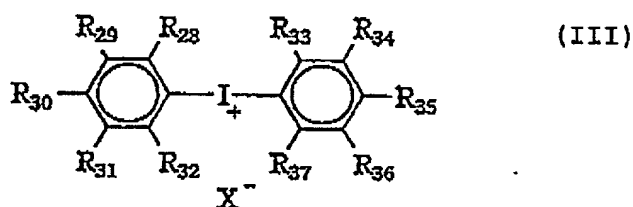
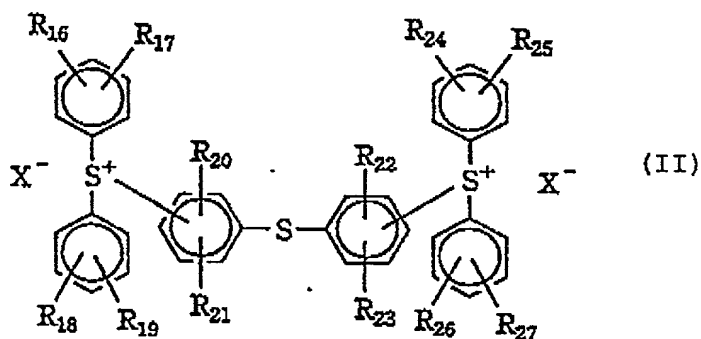
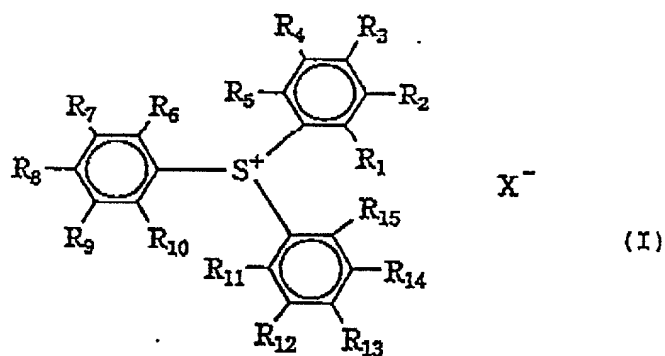
wherein R_{1a} represents a hydrogen atom or a methyl group.

4. The negative resist composition as claimed in claim 1, wherein the resin (A) is a resin represented by formula (2):



wherein R_{1a} to R_{5a} each independently represents a hydrogen atom or a methyl group; R_{6a} to R_{11a} each independently represents a hydrogen atom, an alkyl group having 1 to 4 carbon atoms, an alkoxy group having 1 to 4 carbon atoms, a hydroxyl group or $-\text{C}(=\text{O})\text{O}-\text{R}_{14a}$; R_{14a} represents a hydrogen atom or an alkyl group having 1 to 4 carbon atoms; R_{12a} represents $-\text{COOR}_{15a}$; R_{15a} represents a hydrogen atom or an alkyl group having 1 to 4 carbon atoms; $0 < l \leq 100$; $0 \leq m < 100$; $0 \leq n < 100$; $0 \leq o < 100$; $0 \leq p < 100$; and $l+m+n+o+p=100$.

5. The negative resist composition as claimed in claim 1, wherein the compound (B) contains at least one compound represented by formulae (I) to (III):



wherein R_1 to R_{37} each independently represents a hydrogen atom, an alkyl group, an alkoxy group, a hydroxyl group, a halogen atom or a group represented by $-S-R_{38}$; R_{38} represents an alkyl group or an aryl group; two or more groups selected from R_1 to R_{15} may be bonded to each other, either directly at the ends or

mediated by an atom selected from oxygen, sulfur and nitrogen, to thereby form a cyclic structure; two or more groups selected from R₁₆ to R₂₇ may be bonded to each other, either directly at the ends or mediated by an atom selected from oxygen, sulfur and nitrogen, to thereby form a cyclic structure; two or more groups selected from R₂₈ to R₃₇ may be bonded to each other, either directly at the ends or mediated by an atom selected from oxygen, sulfur and nitrogen, to thereby form a cyclic structure; and X⁻ represents an anion of an acid which is selected from a benzenesulfonic acid, naphthalenesulfonic acid and anthracenesulfonic acid and has at least one organic group selected from the group consisting of alkyl, alkoxyl, acyl, acyloxyl, sulfonyl, sulfonyloxy, sulfonylamino, aryl, aralkyl and alkoxycarbonyl groups.

6. The negative resist composition as claimed in claim 1, wherein the crosslinking agent (C) is a phenol derivative having:

3 to 5 benzene ring-atomic groups in its molecule;
a molecular weight of 1200 or less; and
at least two substituents selected from the group consisting of hydroxymethyl and alkoxymethyl groups in the 3 to 5 benzene ring-atomic groups.

7. The negative resist composition as claimed in claim

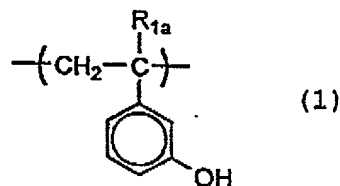
1, which further comprises an organic basic compound.

8. The negative resist composition as claimed in claim 1, which further comprises a surfactant containing at least one of a fluorine atom and silicone atom.

9. The negative resist composition as claimed in claim 1, wherein the resin (A) has a molecular weight distribution (Mw/Mn) of from 1.0 to 1.4.

10. The negative resist composition as claimed in claim 1, wherein the resin (A) has a weight average molecular weight (Mw) of from 2000 to 9000.

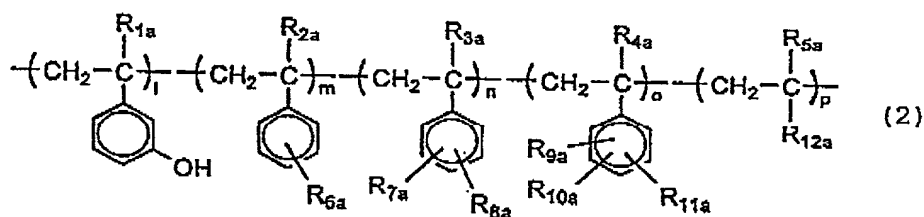
11. The negative resist composition as claimed in claim 2, wherein the resin (A) contains a structural unit represented by formula (1):



wherein R_{1a} represents a hydrogen atom or a methyl group.

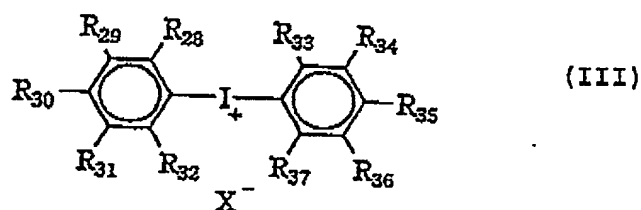
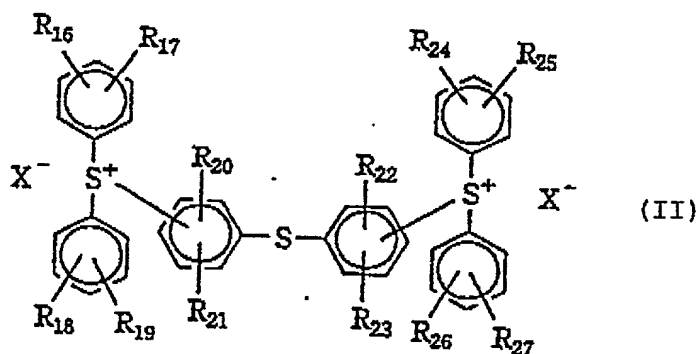
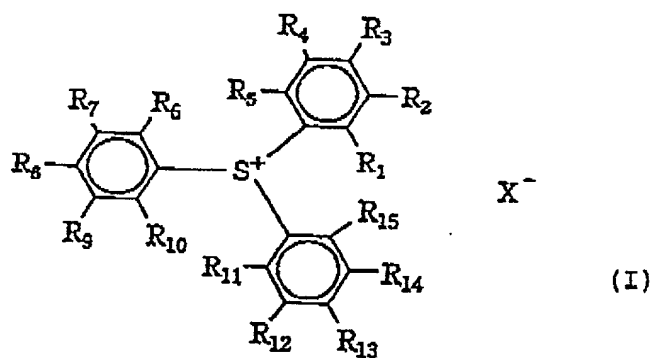
12. The negative resist composition as claimed in claim

2, wherein the resin (A) is a resin represented by formula (2):



wherein R_{1a} to R_{5a} each independently represents a hydrogen atom or a methyl group; R_{6a} to R_{11a} each independently represents a hydrogen atom, an alkyl group having 1 to 4 carbon atoms, an alkoxy group having 1 to 4 carbon atoms, a hydroxyl group or $-\text{C}(=\text{O})\text{O}-\text{R}_{14a}$; R_{14a} represents a hydrogen atom or an alkyl group having 1 to 4 carbon atoms; R_{12a} represents $-\text{COOR}_{15a}$; R_{15a} represents a hydrogen atom or an alkyl group having 1 to 4 carbon atoms; $0 < l \leq 100$; $0 \leq m < 100$; $0 \leq n < 100$; $0 \leq o < 100$; $0 \leq p < 100$; and $l+m+n+o+p=100$.

13. The negative resist composition as claimed in claim 2, wherein the compound (B) contains at least one compound represented by formulae (I) to (III):



wherein R_1 to R_{37} each independently represents a hydrogen atom, an alkyl group, an alkoxyl group, a hydroxyl group, a halogen atom or a group represented by $-S-R_{38}$; R_{38} represents an alkyl group or an aryl group; two or more groups selected from R_1 to R_{15} may be bonded to each other, either directly at the ends or

mediated by an atom selected from oxygen, sulfur and nitrogen, to thereby form a cyclic structure; two or more groups selected from R₁₆ to R₂₇ may be bonded to each other, either directly at the ends or mediated by an atom selected from oxygen, sulfur and nitrogen, to thereby form a cyclic structure; two or more groups selected from R₂₈ to R₃₇ may be bonded to each other, either directly at the ends or mediated by an atom selected from oxygen, sulfur and nitrogen, to thereby form a cyclic structure; and X⁻ represents an anion of an acid which is selected from a benzenesulfonic acid, naphthalenesulfonic acid and anthracenesulfonic acid and has at least one organic group selected from the group consisting of alkyl, alkoxyl, acyl, acyloxyl, sulfonyl, sulfonyloxy, sulfonylamino, aryl, aralkyl and alkoxycarbonyl groups.

14. The negative resist composition as claimed in claim 2, wherein the crosslinking agent (C) is a phenol derivative having:

3 to 5 benzene ring-atomic groups in its molecule;
a molecular weight of 1200 or less; and

at least two substituents selected from the group consisting of hydroxymethyl and alkoxymethyl groups in the 3 to 5 benzene ring-atomic groups.

15. The negative resist composition as claimed in claim

2, which further comprises an organic basic compound.

16. The negative resist composition as claimed in claim 2, which further comprises a surfactant containing at least one of a fluorine atom and silicone atom.

17. The negative resist composition as claimed in claim 2, wherein the resin (A) has the molecular weight distribution (Mw/Mn) of from 1.0 to 1.4.

18. The negative resist composition as claimed in claim 2, wherein the resin (A) has a weight average molecular weight (Mw) of from 2000 to 9000.

19. A method for forming a pattern comprises: applying the negative resist composition according to claim 1 on a substrate to form a resist film; irradiating the resist film with one of an electron beam and X ray; and developing the resist film.

20. A method for forming a pattern comprises: applying the negative resist composition according to claim 2 on a substrate to form a resist film; irradiating the resist film with one of an electron beam and X ray; and developing the resist film.